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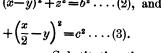
## 15. Proposed by SETH PRATT. C. E., Assyria, Michigan.

From a point in an equilateral triangle, the distances to the angles are, respectively, 20, 28, and 31 rods. Required a side of the triangle.

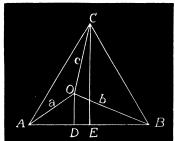
## Solution by J. F. W. SCHEFFER, A. M., Hagerstown, Maryland.

To establish a general formula, we denote the three given lines by a, b, c, and the required side by x.

Let the perpendicular OD=z, AD=y,  $CE = \frac{x}{9} \sqrt{3}$ ,  $AE = \frac{x}{9}$ . Now, we obviously have the three equations:  $y^2 + z^2 = a^2 \dots (1)$ ,  $(x-y)^2+z^2=b^2....(2)$ , and  $(\frac{x}{2}\sqrt{3}-z)^2$ 



Substituting the value of  $y^2 + z^2 = a^2$ in (2), we get  $x^2-2xy=b^2-a^2$ , whence,



 $y = \frac{a^2 - b^2 + x^2}{2\pi}$ ....(4), and the value of  $x^2 + y^2 + z^2$  from (2), in (3) and also

(4) in (3), we obtain after a few easy reductions,  $z = \frac{a^2 + b^2 - 2c^2 + x^2}{2a\pi/3} \dots$  (5).

Substituting (4) and (5) in (1), we have without trouble the quadratic,  $x^4 - (a^2 + b^2 + c^2)x^2 = a^2b^2 + a^2c^2 + b^2c^2 - a^4 - b^4 - c^4$ , whence

 $x^2 = \frac{1}{2} [a^2 + b^2 + c^2 + \sqrt{3} \sqrt{2a^2b^2 + 2a^2c^2 + 2b^2c^2 - a^4 - b^4 - c^4}]$  or if we denote the area of the triangle whose sides are  $a, b, c, by \triangle$ , we obtain the elegant expression,  $x^2 = \frac{1}{2}[a^2 + b^2 + c^2 + 4 \triangle \sqrt{3}]$ .

Substituting numerical values, we find  $x^2 = \frac{3}{2} [715 + \sqrt{401557}] = 44.97 + .$ The minus value of the radical must be rejected for the case that O is without the triangle.

Also solved in various ways by P. S. BERG, J. W. WATSON, H. C. WHITAKER, R. H. YOUNG, G. B. ZERR, L. B. FRAKER, and the PROPOSER.

## 16. Proposed by COLMAN BANCROFT, Professor of Mathematics, Hiram College, Hiram, Ohio.

A traveler whose speed constantly increases in a geometrical progression passes A at 2 o'clock, B at 3:30, C at 4:30, and D at 6:18. At B he is moving at the rate of 12 miles per hour, and at C 18 miles. Find his rate at A and D, and the distance from A to each of the points B, C, and D.

Solution by H. C. WHITAKER, B. S., M. E., Professor of Mathematics, Manual Training School, Philadelphia, Pennsylvania.

Let a denote the rate at A, d the rate at D, r the rate of acceleration At the end of time t after 2 o'clock, the rate will be  $a(1+\frac{r}{a})^n$ , x being the number of times per hour the acceleration is added; this when x is infinite equals  $ae^{tr}$ ; hence the equations  $ae^{1.5r}=12$ ,  $ae^{2.5r}=18$ ,  $ae^{4.3r}=d$ .

The distance = 
$$\int_{0}^{t} ae^{tr}dt = \frac{a}{r}(e^{tr}-1)$$
.

Substituting for e its value 2.71828 and solving these equations,